Notebook Series -- Notebooks by Edison
Notebook, N-17-06-14.1

This notebook is a continuation of N-17-06-08. It was used by Edison in June 1917 to record research performed for the U.S. Navy during World War I. This work was probably done in connection with Edison's attempts at aiding submarine detection. Some of the entries bear notations by Jerry T. Chesler. Included are diagrams and descriptions of experimental amplifiers for detecting sounds, along with notes regarding their performance. The components involved include audions, induction coils, batteries, condensers, telephone receivers, and mirror galvanometers. One set of entries describes experiments to ascertain the cause of "flickering" in audion circuits. The experiments are continued in N-17-06-28.The front cover is labeled "U3." The book contains 100 numbered pages; page 100 is blank.

17-06-17

14th June 1917 1

8pm start,

U18 in — 3 audions — 180 cells

Leclanche - 37.1 milamp on

duralum, phanaplex 2"

away — nothing —

3 audion

Changed to better Condensers

& Lamps —

got at 3" 5" throw

& 3½ = 2" throw

This is Best yet,

Soon after Audion got

Kicking & its kept

up till nearly morning

We now have assembled on glass with Norman & Lobey Coils 1 audion —

3 Audion Lamps —

160-Lalande Cells —

While Jimmy got 1½ swing with phanplex 1" away the audion gives 6" — also 2" at 1½ away of phonoplex & ½" when 2" make away —

Lobey Coil as input Coil & Norman as output Coil —

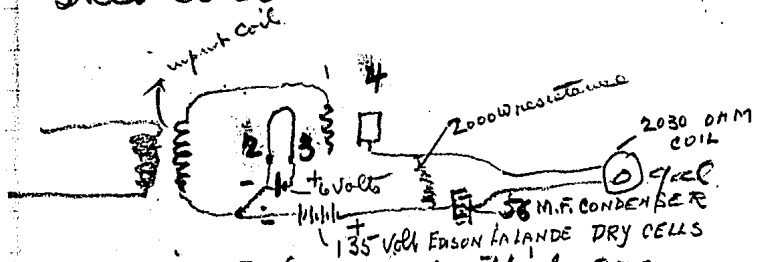
June 15 — 8 PM.

1 Audion — output Using Condenser 56 mf
for output, and 4 Western
Elec Coils, 900 - 600,000 - Coils.
Secondary in series, primary
in series — used as input Coil

2000 Res shunted across
Condenser — thru which
big battery passes —

at 2½" away of phonoplex
got ½ — at 3" away
1/8 of inch —
at 1 inch goes off
scale

This is connections



Using 3 Lamps in Multiple are
4 Western Elec receivers
TYPE "L" WESTERN ELECTRIC AUDION BULBS USED.

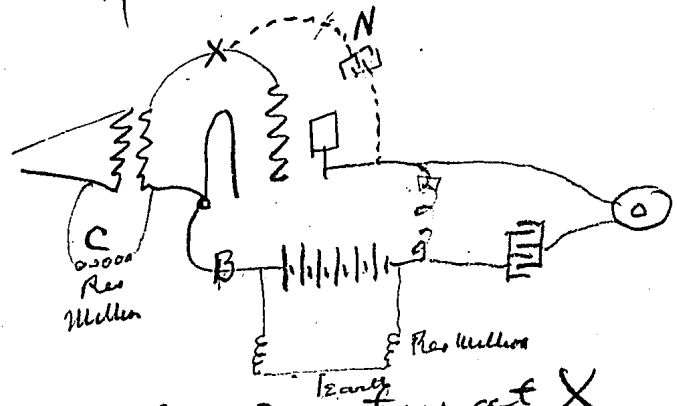
Putting primaries of the four Western Elect input coils in multiple and leaving secondaries in series practically no change. Perhaps it is a little better with all coils in series. When all coils were put in multiple

got about same deflection as one coil in circuit.

Put in 92 microfarad condenser in output circuit the deflection began to fluctuate and act unsteady. ~~Put~~ Cut out the extra capacity, we now have only the 56 m.F. condenser in output circuit. Cutting out 14 microfarads the deflection was cut down. Put back 56 microfarads

We now cut 6000 ohms across output line instead of the 2000 ohms. and we get about 5/8" deflection. a little better than before.

An Experiment



36 microfarads put in at X

Phonoplex 2 1/2" away deflection 1/2 about same, does no harm.

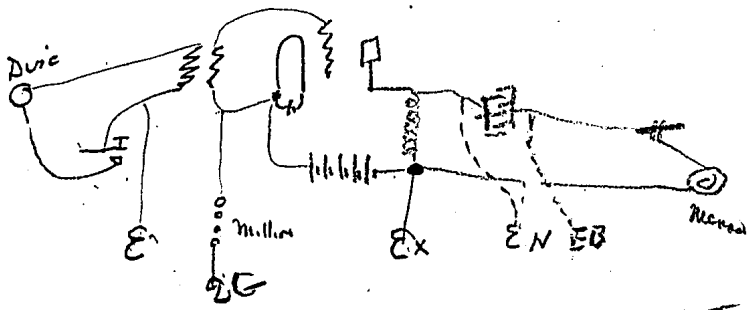
We now try condenser at B get nothing

We now put it across N
~~[illegible]~~ get a little of phonoplex
but discharge takes place
with fingers on Key
just same —

In place of a Condenser
across N we put a
Million Ohms, ~~[illegible]~~
Indian Ink strip —

Think I get phonoplex not
certain — Zero shifts
sensitive to fingers on
Key — think Condensers
leak well Split &
try Equal 1/2 — No change
Million ohms at N was in

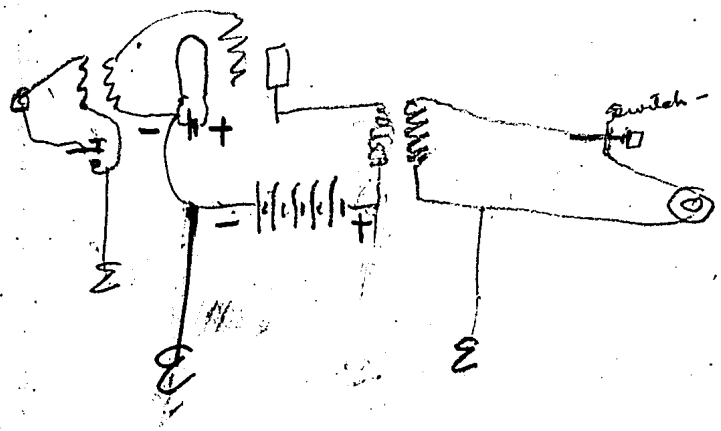
We now remove Res at N-
and put a resistance around
big battery & Earth the
middle of it to permanently
discharge the System to
Earth,
Kicks more than Ever with
jumper on Key
We remove the resistances
& put them at C Connecting
primary & secondary Resist
Million Ohms at C



first try Ex ~~EG~~ + Ex fing substitute
En for Ex —

We get no deflection on Key
by fingers — but
EN. shifts zero to left several
whole of deflection + EB used
shifts zero to right reversal
makes this always
leaky Condenser

We now disconnect Condenser & substitute Nerimmo big Coil



No kick anywhere Each system grounded 6 Volts sec $1\frac{1}{4}$" with phonoplex 2" away. perfectly steady

Notwithstanding Touch Keys
Switch or any part of
Audion —
with this arrangement
Phonaplex 2"
One audion bulb in — 1/2" Thrown
Two 3/4 "
Three 1 1/4 "
Four 1 1/4 no change
Five 1 1/4 "

3 with present transformers
is as most practical
(5 WE input Coils both primary & in series) no Condensers or
Silver Cells, or Leak Coils
Except Earth wire
as per diagram No 2

Got another audion wkg
Storage battery — the 1st one
has Leakage. which is
steady while 2 Bat beats needle
with Key open account 1/8 inch
for some reason (Key is
Connected to input)

Both audions separately
give scant 1/2 when
phonoplex is 2" away

Now we will learn

if 2 Audions Each a
seperate Entity will
work together & amplify
properly without
the Jerky Extra
Currents —

We make the filament battery
audion the first audion
at Input

get $5\frac{1}{2}$" Throw at
2" phonoplex

$2\frac{1}{2}$ — Kicks but its $1\frac{1}{2}$ swing
its the gas of battery that kicks

Amplifying Ratio

1 to 2		1 to 4		1 to 6	
1 direct	-				
1 audion	2	1 audion	4	1 audion	6
2	4	2	16	2	36
3	8	3	64	3	216
4	16	4	256	4	1296
5	32	5	1024	5	7776
6	64	6	4096	6	46656

8 to 1		10 to 1	
1 Audion	8	1 Audion	10
2	64	2	100
3	512	3	1000
4	4096	4	10000
5	32768	5	100000
6	262144	6	1 million

Thursday 21 1917

We now have 2 audions -
Each with 96 Delande in
tumblers, 125 amp hour Capacity
of Liquid is changed several
times, These Cells are in
glass tumblers & pretty well
Insulated -
2nd audion - 5 WE Coils -
all primaries in series, delta
secondaries - This is Input
Output Coil is Nerimus

1st audion - Input coil
our new big one + Loebwoch
for output,
at 2" away of

Phonoplex get 1 3/4"
throw, Steady — no static.
at 1½" was 5½ throw

When we tried the Lelande
little dry added 88 Volts
in batt. Cardon it
flickered, Took them out
& added 50 V Storage
battery to each Cardon
it still flickered, Took
them out leaving only
Jumbler battery no
flicker — There is
creeping of the 2 storage
also old dry & alas

Note

Lorbowly Transformer
has part of 1 Coil
short ckt should be
345 ohm is only
245 —

We are using 3 audion
Lamps to each set

Variable Currents from
crossing —
Wear only highly insulated
Wires will answer —

We now on No 1 audion
shift the Lorbowly output
Coil over to an Input
Coil & our new big Coil
to output Coil —

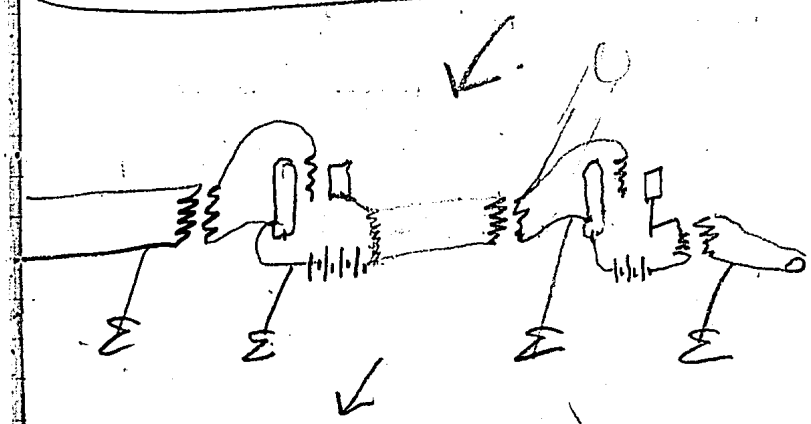
Don't get anything
at 2" Something wrong
are changing back

Friday p.m.

Connected Kwarm Transformer with all primary winding in series and all secondary winding in series using same as input transformer on first audion. For output coil used Liebowitz transformer with 8 coils in series for primary and 4 coils in series in secondary. Get a 5" deflection when phonoplex is 2" away.

Second audion set has 5 W.E. Input coils primaries in series —

and secondary in series.
for output transformer
using train with switch.
each Audion set has 3
type L M.E. Bulbs.
Each Audion set has
96 Leland cells in series
for grid current.
Changing input coil
to give 60 to 1 instead
of 40 to 1 no improvement
Changing output coil
to give 2½ to 1 no
improvement, smaller
deflection. Changing
output coil to give
1½ to 1 – deflection becomes
unsteady and jumps.
We have just found another
M.E. input coil and will
add same in series
with 5 now connected
on second audion set



We try this to get rid
of ½ the transformers

At times audions especially 1 audion is absolutely quiet mirror spot steady at zero. Sometimes 2 audions are perfectly quiet. Then they will start to flicker moderately & other times violently, without any change in the apparatus. Possibly Wireless or induction or Earth tremors + atmospheric charges or Electrification, or lightning — or variation of battery Currents, or creeping insulation is Causing hygroscopic atmos Ele.

Sunday 23rd 1917

Experiments to ascertain Cause of flicker or unsteadiness of Audion Circuits —

No change from Saturday —

1 Audion, on very slight tremor, Electric Current Cut off in building — Slowly Bat on Mirror Lamp — current off mirror absolutely steady showing no jars —

2 Audions — with Current Cut out of building, light flickers 1" to 6" continuously put in a phone in Mirror Ckt Jerry hears it plain its in snaps & also a a weaker Continuous

With my Key 9 open phonoplex
Ckt going to condition —
but on opening the wire was
still connected + acted as an
antenna = apparently on
opening both the flickering
was less maximum 1¼ unequally,
on closing
the input coil + cutting
off the phonoplex circuit
The throw was 6 and 2" to 6@8
No improvement,

Jerry on phone usent — Mirror
Circuit thinks he hears voiceless
Calls Etc = Opened switch of
Mirror put most hand.

across, Jerry hears steady noise but stops + big clat disapper + Mirror sounds at perfect quiet –

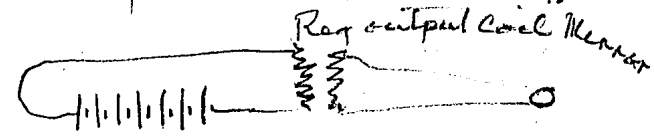
Grounds all Taken off –
Mirror Wires just the Ocean – 6@8"

Jerry thinks he hear the movement of a Cordless Engine —

We now ask Rocco house Phone co. to pull scotch + disconnect our buildings around us –
He cant do it, although opens Every scotch – fine system (last hour)
Dimmiddue will disconnect at roof of our building

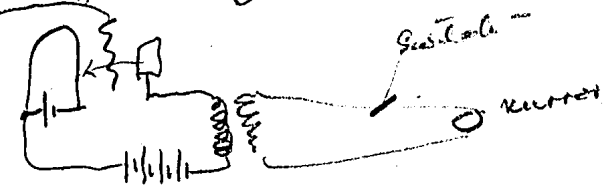
Where there is a fuze plug he cant do it.
So we will go on our other Experiments

#1



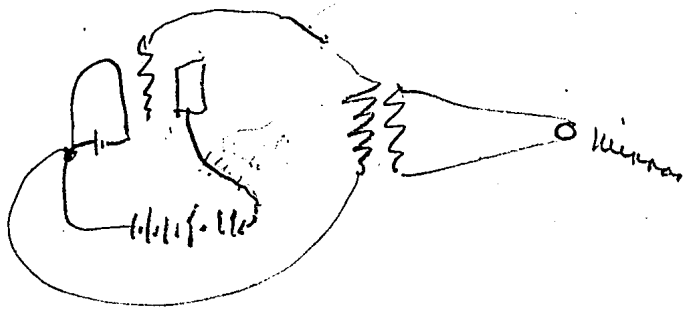
Listen also note mirror — 2 amp from battery. This is too strong without Resistance in —
25 Milamp — Needle steady
Hear nothing in phone
No click on opening or Closing Mirror ckt.

Experiment #2 3 bulbs in Multiple



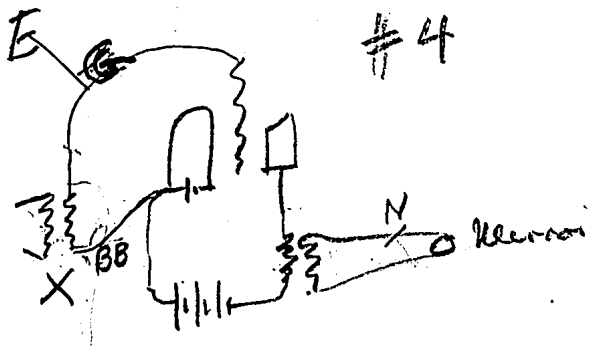
10 milliamp flow from plate to lamp fil

Constant no movement of mirror
no sound in phone -



Mirror absolutely zero - no sound
in phone,

#4



Input coil in Out Open primary on
t. steady - no sound -
But when X wire comes
Even gently Tapped with
wooden pen mine goes off
scale -
disconnected grid from X
steady. Knocking doesn't
do anything
WE connect ground wire
to G freq 4 - steady but

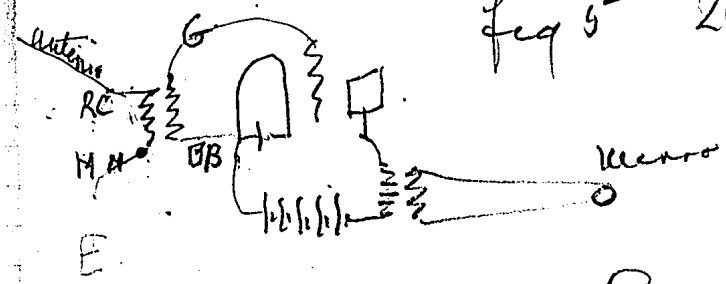
The Secondary Coil connected to grid must be highly insulated apparently so grid cannot discharge Electron Charges to Earth,

When I touch switch in Mirror Switch N with hand throw in several inches which comes to Zero if hand held on

We need shift ground from G over to BB-fig 4.

Dont give any throw now with hand —

This shows we dont want any grounds of G in any Event as it discharges the grid.



We disconnect ground from G + BB + put the binding wiring to primary at RC using it as an antenna —

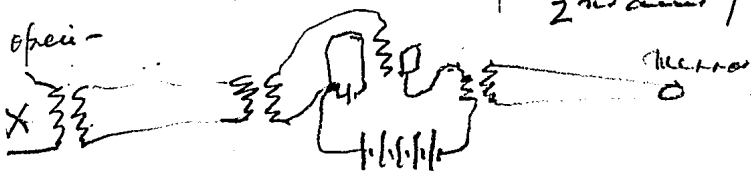
Do not get any sound needle nearly quiet 1/32 jar at times may be only jar

We now ground the other end of primary input which was open in above Experiment - the needle at times vibrates 1/8 - but its fairly steady at Zero.

1st audion

fig 6 — 2nd audion

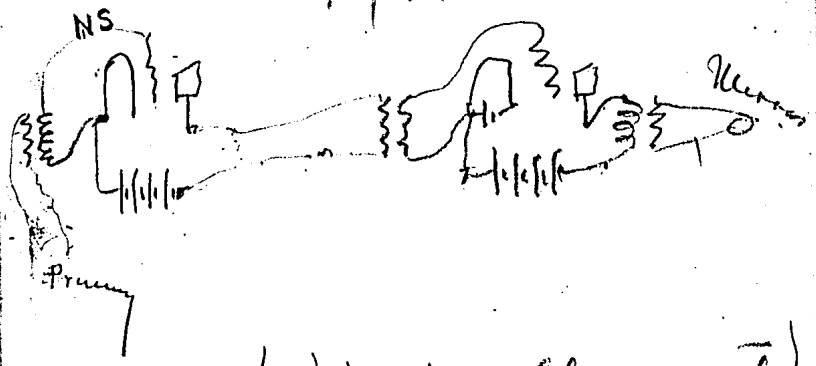
27



All grounds off — We notice
Connect to secondary of
No 1 audion output coil:
Secondary — primary being
open — when X closed only bells
throw —
(This is only coil on No 1 audion)
Needle steady — faint tremor
1st audion coil is very
insensitive to knocks with
wooden pin whereas
the 2nd audion input
coil is very sensitive

2nd induction coil made wrong
too many Contacts
whereas 1st induction
Coil has only 4 Contacts
at plates, hence less
secondary

Fig 7



Lights at roof disconnected
Primary open leading to phonograph
branches 1/2" at lines —
after lights at roof Connected

get 1" at times & 8" throw when scratch first closed

Now put primary repeat cardiron 1 on phonoplex with 1 cell in Phonoplex ckt, current open at key get the usual continuous hum Edison Cam just hear this dont throw needle scarcely any — When key closed get the click & then it swings & needle violently agitated off scale as long at it hums, by opening key

hard hum stops + weak hum appears, sometimes the hard hum flickers, is choppy
I notice when key is open + only weak hum is heard a momentary touch of key stops weak hum for say 1 sec when it appears if I hold key closed longer it takes 3 or 4 seconds to appear.

We now take out battery from phonoplex ckt & put it in at NS fig 7

The note of Loud hum is even
louder & apparently lower
note,

phonoplex off — pressing
input closed - no hum but
just rumble that throws needle
3 @ 4" — battery at NS in -

Now Gallery at NS out,
just same - throw & rumbles

WE now disconnect
all wiring with 4 wires
with Colors & use

I should mention that when switch connecting building wiring to phonograph line needle jumps several inches —

Putting on phonograph circuit brings the hum strong & big throw of needle,

We must be sure that no induction current at output end of the 2 audions ever goes back to the input circuit as it once did

Twisted 2 wires rubber coated this to simplify matters for serving with tin foil.

We leave out the branch of phonograph circuit which runs to Mirror for fear it takes back a wave to 1st audion from the 2nd

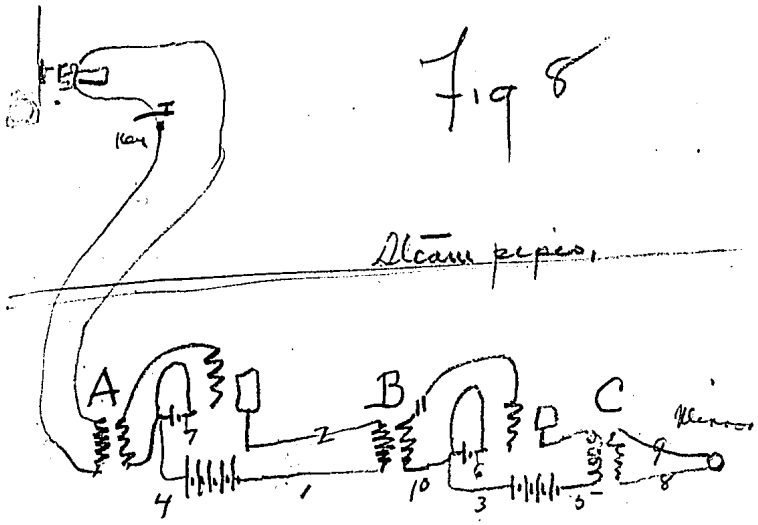
The Mirror itself generates a wave & might throw it into this branch circuit & start it back the audion again

GUE

There is a possibility of C throwing Magnetic or Electric lines into B + B into A thus ruining perfect Valve action, Lead covering + Enclosures of A B + C in closed iron boxes

The Steam pipes may get Magnetized by transformer + gives an oscillating wave Especially C as it has many outside lines & B also is not good.

Fig 8



Plain twisted rubber wire all thru no return wires to input of No 1 coil no ground wires

Phonoplex wires entirely disconnected primary of A closed — Swings from Zero to 4 @ 5" at times, Jerry says Hums but I can't hear it so its lower in Volume

2nd Change Feb 8

We now put lead covered cord from Mirror to 2nd audion output & from 2nd audion input to 1st audion receiver.

A primary short circuited before grounding lead Mirror swung bad & got loud hum when grounded lead of one section, hum & throw want lead, on grounding the other section off lead I couldn't hear hum Jenny says very faint yet very weak snap

Mirror, 1½ to 4" throw no quick jerks - but mostly 1½ & low

fig 8 still -

We move the Transformer away from the steam pipe to see if any diminution of splitthering, still throbs 1 t. 4' but lights are on now.

We now make 1 2 3 4 5 6 7 8 + 9 10+11 wires served with tin foil & grounded 8+9 are lead covered cables ditto 1 + 2 + all grounded

Moved magnets away from steam pipes no diminution of throbbing +

Served the places mentioned but it lessens if some + so

peculiar can see light spots at several places, in a throw of 3 inches - going days no hum only spluttering on phone - all the lead coated wires have lead grounded -
Cutting light lens out building makes no change —
grounding the crow of all the transformers no change —

We changed the direction of connection of 6 cell filament battery

This immediately stopped
the several mirror images -
& throw came way down
to 1/4" With NO 1 audion
input closed, Jerry
says very quiet in
phone —

We now Reverse filament
battery 6 cells on NO 2
audion —

Mirror spot Perfectly
quiet not a stir —

The Question now is will
audion amplify

Cant understand why
Reversing the 6 cells
of filament battery should
destroy amplification
+ also throbbing -

It does not amplify
only 1 ½ swing when
phonoplex 1" away
which is accum
direct,

The old way is 6 cell battery
has neg to filament
where big battery
has negative -
As we have it reversed
we have positive to
filament where neg end
of big battery is connected

Western Elec Coils

Primary - 2.65

Secondary 1800 ohms

Note

$5\frac{1}{2}$ throw at 2" is best we ever had

see page 12

4 grid circuit.

We now reverse battery back to old place (6 cells) — on 2nd audion but keep it reversed on 1st audion.

We get 10 to 12" on 1" away of phonoplex $4\frac{1}{2}$ at $1\frac{1}{2}$ meters away of phonoplex + $1\frac{1}{4}$ at 2" away of phonoplex. with

4000 ohms resistance in 2 spools in final transformer primary — The Res of primary is so low had to put in this resistance to keep battery current (96 cells) down — This of course weakens phonoplex wave Eng Mech =

Ferry just finds 4000 ohm Coils not necessary he must have had a Crossconnections when he had to put them in

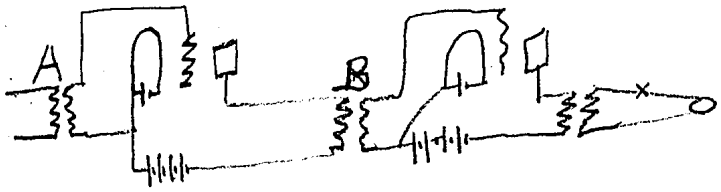
to get amplification
one of the 6' Cell batteries
must be connected the
opposite of the other
loud holler will cause
meter needle to jump which
should not be -

The input transformer
secondary of audion
2" of one of 6 ohm
ends of coils touched
meter goes off scale

fig 9

Possibly a Condenser at X would give both sides of the wave, but not more power

fig 9



If say a Negative wave passes from A input to the grid system it gets thru to B. Now B secondary must be connected so a Negative wave enters 2nd audion grid system to get amplification. If a Positive wave enters it will not pass only a general inductive weak wave may get thru so its not a matter of indifference as to how terminals of B

Secondary is Connected to
grid system on a 2nd audion —

We found that while Connected
wrong at B so no amplification
that by Reversing the 6" Cells
on filament we got
amplification + Dont quite
understand this —
When polarity of each of
the 6 Cell filament Cells
on No 1 + 2 audion the
way we happen to have
things arranged that
there was no amplification
got about what we
could get direct —
to wit 1½" when

Phonoplex cut at 1"
But moment LOE made
polarity opposite on 6
cells of no 2 ambion
got 4 to 5" when phonoplex
2" away, but it was
not very bloody -

Monday — 25 June 17

We now have all the covered possible use Lead cable (2 wires twisted)

We get at 1½" phonoplex 7½"
2 " "

Its not steady - 2" reading uncertain

We now make both filament 6 cells
Neg to grid -

2" phonoplex 12" or more Ilwaco East
unsteady - When thrown & tapped
gives 3 to 4" & flickers -

Thus changing one of the 6 filament
cells - We enormously increase amplifying

We reverse Secondary on #2 audion – it is not quite so great amplifying Jerry Sago very quiet on phone very faint hum

Phonograph stopped,

Swing 2 to 5 inches –

We now reverse 6 cell fil battery on #2 audion –

Now very little swing 1/4" good though altered –

No amplification.

We now reverse Secondary back to original (#audion 2 input)

Keeping 6 cell battery same though altered

No amplification –

We now reverse 6 cell back to neg to grid.

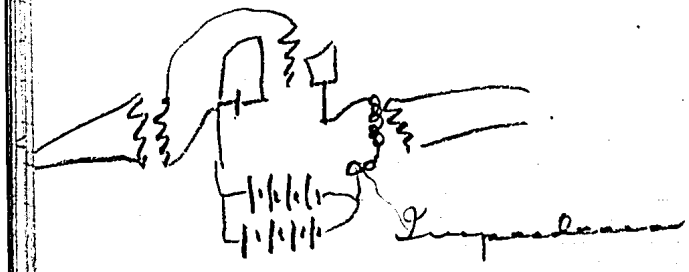
Big amplification but unsteady
When phonograph stopped swings
from zero to 6@8 makes very
unsteady -

Disconnected buildings by
some outside - No change -
flicker's just same

We now connect each separate
system of studios to earth.
The lead covering is already
grounded No improvement

We put a shunt around
#1 Audion 96 cell battery

The proper way to stop slight changes of the 100 Volt battery from amplifying is to use 2 batteries in multiple & an impedance in the circuit of the bulb. Then the changes will take place in the 2 batteries & not go out into the bulb circuit.



is just as flickery. Shunt passes 20 mil amp -

We now shunt the two Leclanche (9 cells) to pass 20 mil amp thru the shunt & put an impedence in the line leading to plate in bulb so that any variation in battery goes around shunt & the impedence keeps it from going into bulb circuit

get on 2" phonoplex 1" throw pretty clearly - at $1\frac{1}{2}$ get 2 to $2\frac{1}{4}$ throw -

Transco

Has 200 ft $2\frac{3}{8} \times \frac{1}{16}$

46.00 per ft

also 500 ft

$2\frac{1}{4} \times \frac{1}{16}$ –

42.90 per 100 ft

Shunt & impedance on both channels

Phonoplex $1\frac{1}{2}$ – 4"

throw – used 1800 ohm WElec induction coil for impedance

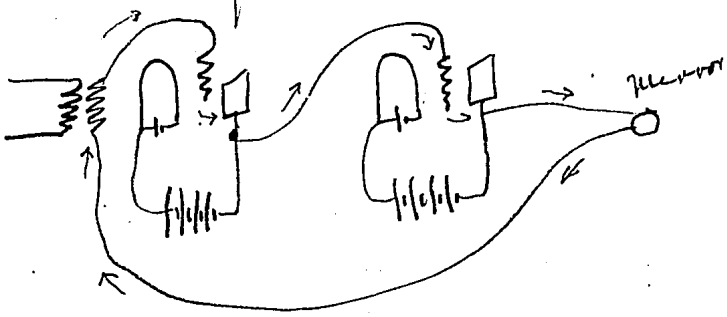
took out & substituted open magnetic small FR impedance coils NG throw with phonoplex clapper, Seo-end makes irregular –

We now put back two 1800 ohm WElec Ind Coils, closed mag ckt in multiple making 900 ohms total – done on both channels

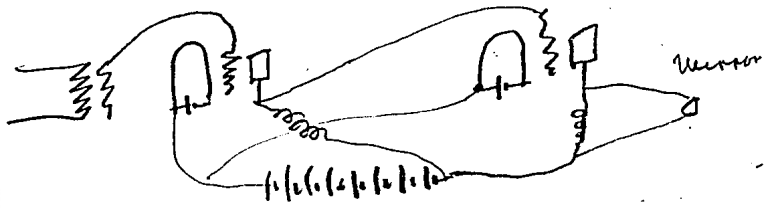
Oscillations going on —
get 4 @ 4½ with phonoplex
2" away — phone clapped
flickers ¼ to 1½ — Cannot
work this, no hum but annoying
flicker —

We multiple arc each set
of headers on each audion —
Double 1000 ohm inductance
in each bulb, plate circuit
Quite steady — phonoplex
2" get 1" throw

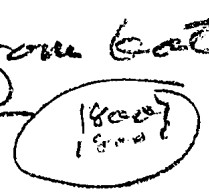
This might work



and this



We now take out the inductance from both audions



Evening Monday 25 1917

We have 1st & 2nd audion Input Coils in electrion boxes, also 1st audion Lamps. — With phonoplex 2" away get 4 1/2 throw pretty steady — with Phonograph clapped swing at most to 1 inch & Easy — This is very good

We now put second audion bulbs in iron box

The 6 filament cells both ~~were~~ positive to p of big battery

This -

The balance on each audion is in multiple with 4000 ohm shunt around the two multiplied batteries taking 20 mil amps - only 15 mil amp passing to bulbs in one audion & 10 in another approximately -

This is Conclusions of Experiment on page 51 ——

Opened Light Ckt outside bldg no change -

Both Audions in iron boxes

Almost quiet sometimes for 10 sec then only a occasional dand throwing 3/4" — phono-plays 2" gives 4" throw steady This is best yet for quiet

Output Coil not yet in iron box —

Rec Storage Cells on filaments

Above is results —

Shunt around batteries removed — phonograph stopped

Considerably more unquiet 2 sec zero then sharp jerk then quiet 1 sec then $2\frac{1}{2}$" + so on

Battery has something to do with unquiet — say double —
So we must get a more Even Resistance battery —

on starting phonoplex goes a little more complaccable about $4\frac{1}{2}$" swing steady — but $4\frac{1}{2}$ was limit 3 steady —

We now put the two sections of Lelande in series, on both cudions — as originally — without shunt. —
It now on 2" phonoplex swings 8 inches steady — fairly so — widening to 10" + going to 6 — lowest

BEST YET 55

phonoplex stopped more unquiet than before zero to 3 & 4 inches but most of the time - zero to 2 @ 3 inches showing several mirror spots - showing rapid discharges

at $2\frac{1}{2}$" phonoplex

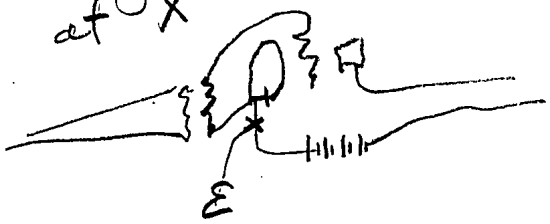
at 2" phonoplex this is very practical for detecting with its throw of 10' max & 6" minimum & steady —

We tried a 6 Volt lamp shunted around 6 Volt

Trouble is

Static —

filament battery in condition, didn't do any good but found meter went off scale when he touched battery — fearing this static was leaking in jerks we grounded it at X



This made meter spot practically steady at zero + is an improvement possibly not sure

Tuesday mng June 26 1917

We changed the Storage battery on filaments for 200 amp hour Lalanda at glass arm — Phonograph stopped quite irregular goes as high as 6" see the flashing of Mirror — no spots. — Amplification 6 @ 8" with 2" phonaplex

This shows that its not filament battery —

We put back storage Battery —

Phenomenon

With phonoplex Ckt open Mirror stands Zero but moment that circuit is closed phonoplex in or out

We get unsteady jumps -
Something Extraneous must
affect the primary C.C.
of the ~~Pr~~ Input
transformer, that dont
affect the secondary
It cannot affect the iron
core for then we would
get jumps ~~after~~ by the
action of the secondary
Where does it
come from
?

We have it very unsteady.
this pin jerks to 6 & 8 inches
find that pulling 20 or 30
Mufard Condenser in line that
it cuts it down to 1 @ 2" at
times & fairly steady
& OK for work at 2"
Phenoplex at a time when
fluttering is at its worst.
Why the Condenser does it
Cant say — We put a
ground on primary input
no change but claps
flicks on fingers Touch

We put the Condensers

in right at balance of phonoplex ckt to input primary - throw amace ϕ - maximum 2" mostly zero - Apparently no different than when at phonoplex itself -

We now put 1/2 the condenser in one leg of phonoplex circuit & 1/2 in the other, Only 1 1/2" amplifctn at 2" phonoplex in this case - This is because The two actions are in series - hence Mirror gets no throws on account low amplification -

We now keep Condensers in series but add to each lot. to bring up amplification amplers to 2 @ 2 ½"

Now we put both lots of Condensers in One leg or all Multiple — gumps 3 or 4"

Condensers are of very little dose apparently — without these experts are vitrated by a leaking Condenser in the lot,

We now take Condensers
out + Open circuit
across Circuit we put
The Queen Res +
Pencil gal - 10 000 ohm
+ see how it beats

Needle Zero no movement
we now start phonoplex +
amplifier OK —
No stop phonoplex -
but ckt closed —
Jumpi - ~~[illegible]~~ 3 or 4"

Now Cut Res to 5000
then 2000 No change

as phonoplex so low in Res

Put coil in series
shorted phonoplex

10000	no swing
5000	1/8"
2000	1"
1000	2
500	3
250	3.

Nothing in this ——

We now try in a high
Resistance phone in place
of phonoplex – Res 2000

This keeps Mirror practically
Zero. maximum throw 1/2" only rarely

90% of the time Zero —
Phone 1" away 60% much
Throw —

Replaced phonoplex
& put it in primary
Circuit of Reg WE Elec
Induction Coil Secondary
to primary of input
Circuit 2" away
got nothing when
phonoplex running

Reversed WE Coil put
primary to input Coil
& secondary to phonoplex

no change no throw but
notice flicker just ~~some~~
This being the case
it looks as if the
flicker was composed
of spurts of very high
frequency waves or it
would not amplify
when Phonoplex fails
to give anything thru
the 10 Elec high frequency
Coils - if its high
frequency it cannot
get thru induction with
its 3 Low frequency

Direct tests without amplifier

Phonoplex 1" away Throw 1 3/4 -

phonoplex 1/2 away 15 1/2 throw -

phonoplex 1 1/2 throw 1/4"

2000 ohm phone (Cabot Holzer)

1" away 1/4 inch throw -

1/2 " 3" throw -

1/4 " 14 3/4

Flat phone Value 4/10 of the phonoplex letter at 2" is same as flat phone at 8/10th of inch -

Coils, Yet it does get thru to the Mirror - or it wouldn't beat, -

Put 5 WEles Coils in Phonoplex ckt, primaries in series & secondaries in series -

Phonoplex in primary no throw at 2" at 1 1/2" got 1" throw but slight flickering is there -

We will call the 2000 ohm flat Bell HC -

Biggest Improvement

Yet =

High Resistance

Phone for feeding

Audion, reduces

splutter way down

will rewind phonoplex

We now put HC 8/10th of

inch away from disc on lower

2 audions —

Quiet mostly Zero jumps 1"

now & then but generally

OK — Throw $8\frac{1}{4}$ = good

Now we put in (in place of

HC) the phonoplex at

2" away —

Phono stopped

Jumps bad, nearly all time

5" throw up to 8"

Very bad —

Phonograph on —

Wobbles bad but mean

throw not over 8"

Hence HC is 40% of strength of phonoplex

If phonoplex is 1" away from disc on lever HC should be 4/10ths of inch to get same deflection -

With HC in circuit the spluttering is reduced so it dont bother say at 8/10th inch

Whereas if phonoplex is in at 2" the spluttering is several inches

While the real amplitude is the same Hence Audion

Big Improvement using High Res. winding on Receiving from sea phone —

Rewound phonoplex Each Coil 5000 turns .002 single silk Covered Resistance each spool 2550 ohms Total 10000 turns 5100 ohms —

Direct without audion gives 3/4 of inch throw ~~[illegible]~~ at 1½" away whereas old winding of 96 ohms that we have been using right along only gives 1/4" throw — showing big gain by fine winding. at 2" away it was a billion better than old phone at 1½

We now put Audions on - phonograph clapped -

Hands at Zero with about 1/8" movement every few seconds goes to 1" this runs along for 1/2 a minute then it starts & jumps 4" 2 or three times & then settles back to nearly Zero. — Very sensitive to shocks

We put ground on 1st Audion filament where by last connection not so sensitive to shocks + keeps nearly Zero =

Now phonoplex 2 1/2" away scarcely any throw —

2" away only 1" throw —

1 1/2" away only 6" throw

Think we are fooled in testing direct, as our Mirror Coil is 2000 ohms & of course a high phone will give better results than a low res phone

Evidently the input primary is too low resistance for the high res new winding

Very now discards all the primary coils, on 1st audion as primary input transform + will use 2 of the ~~so~~ 6 secondaries as a primary as they are very high Resistance, he will now connect in primary coils + use them ~~as the~~ with the 2 coils. coils

No Results at $2\frac{1}{2}$ or 2" away beats bad when phone clapped but gives probably 3½" entering

Idea —
Put a low Res Crystal Rectifier in phonoplex circuit so no come back Current possible —

Idea 2 = Shunt whole of the Audion system from phonoplex circuit to mirror (1 side) + put in high resistance — This stops band waves —

also put in 1 battery cell in phonoplex ckt in right direction, to stop alternations in primary

We now put back all coils on No 1 audion input transformer as they originally were + We will multiple are the new phonoplex winding to reduce Resistance from 5000 ohms to 1250 — This ought to fit the input coil better than the Original 90 ohms —

This when phonogh stopped gives Zero 8/10ths of the time now + then it jumps to 1 inch This is a good practical quiet as well

NOTE

Phonoplex 2" away
gives a very steady
$4\frac{1}{2}$ inches
BEST & MOST
Practical point
reached yet,
not sensitive to shout
jar or walking —
Will hold this for actual
use until we get
something better

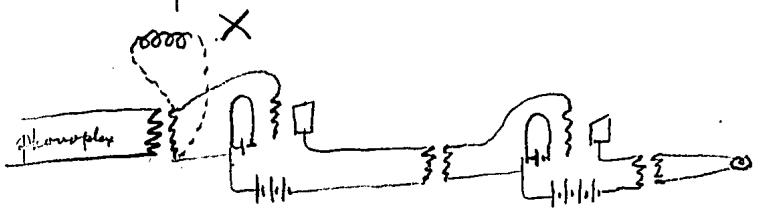
Further Experiments -

We disconnect both Audion Lamp batteries ~~which~~ and substitute freshly charged batteries, - as Voltage is too high we put in resistance. as there is a gas Voltage + much gas we well aware of its more unquiet than the old batteries when phonograph is stopped

Unquiet about same, might be shade more.

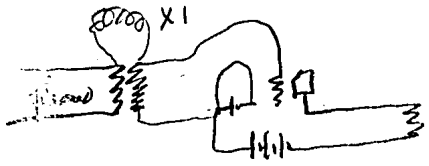
Amplifier 5" with phonoplex 2" away

New Expts —



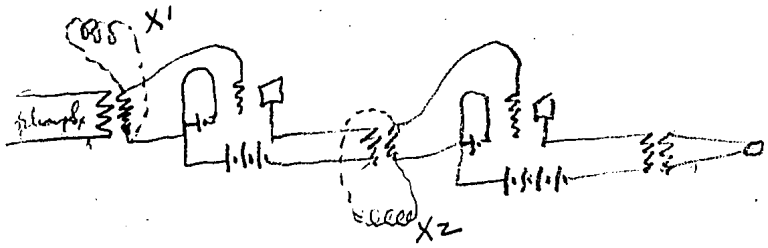
X is a shunt 48000 ohms —

Dead steady when phonograph stopped —
amplification is hurt gives at 2" phonoplex 1 1/4 inches also dead steady —
96,000 ohms amplification 2"



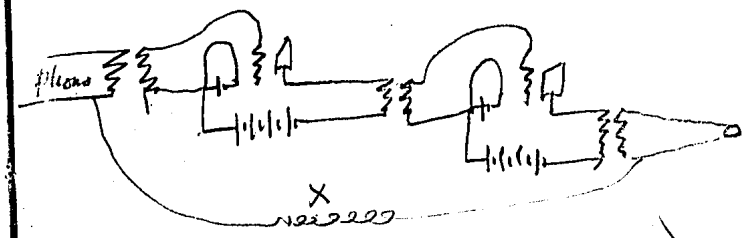
X1 — across secondary + primary
no results same as if it was not on

Experiment



X1 96000 ohm shunt
X2 " " " } both across secondaries

Head steady — phono stopped
1" throw. phono Running
NG —



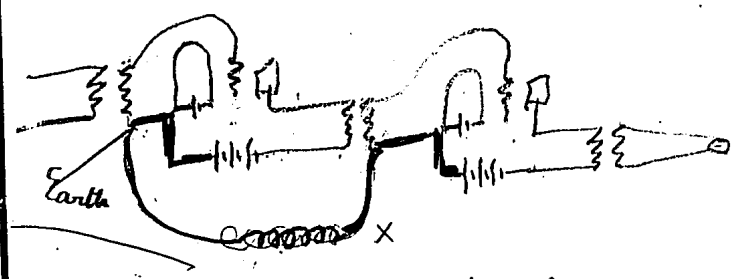
X is 192 000 ohm shunt around Audion —

No phonograph — Little worse than without anything
phonograph going 4 1/2
NG

78 1/2

The Wire used in shunt was covered with lead, & lead grounded — I did not mean to use this, what I wanted was Rubber wire with the ohms in well by itself again

Expt 78



X 192000 ohms — shunt.

Phenomenon — Vibrate perfectly steady — needle goes so fast Cant hear it, listening in phone Edison hears it loud but dull vibrations but perfectly even & about 15 to 20 sec

put in 384000 ohms — phone shows waves not quite so loud but about 1/2 the number per second say 8 or 10 a second

We double Resistance again making 768,000 ohms not quite so loud duller & less per second

Static Theory
Busted -
Its Defective
Insulation
Later wrong

Experiment on page 79
78 Continued —

We put a Million ohm. India
ink Res in - about same
Edison hears it strong in
phone its about 5 to 6 per
second —

2 Million ohms in - slightly
slower + duller needle
so far as thrown so powerfull
Jerky hears it knocking
against Rubber - Can't see it
on scale -

now 5 Million Ohms -
Edison - hears it still now it is
very fast 50 or more second

Experiment on page 78
Continued —

We now put in 7 Million
ohms —
Edison Cant hear it
Jersey says he hears it
strong & its much
faster —
Needle mirror jumps
all over scale from end to
end — see spots.

See page 78 ½ left side
for Explanations — we
been using lead covered
wire grounded, what
I intended use was
Rubber wire & Resin

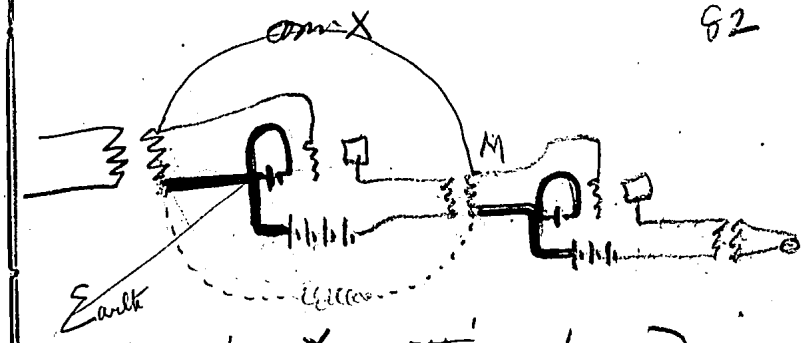
We try Experiment over again —

Using a single rubber
Covered wire and
7 Million Ohms in
Circuit, Connected as
per diagram on page
78 —

Now 7 Million on Edison hears it

See diagram page 78
Only get it in phone when the
wire of shunt is touched
wire are on the black lines —
If shunt is put thus

If Coil M is reversed
don't get vibrations



Shunt here X, nothing heard in phones.

But shunt shown in dotted lines we get the very strong vibrations, which have varying rates of vibration. Paulsen galv vibrates 1/4 to 3/8 like a Reed. Its an oscillation.

Any leak in the Coils or between the black lines of No 1 & 2 Audion will cause these oscillations & violent movement

Note = These Experiments may have been affected by the ground as shown in diagrams on pages 78 + 82 –

We are testing to see if leakage between primary + secondary of No 2 audion – after that will make the Experiments over with ground off

of the Mirror so nothing can be seen of it with 5 million ohms in – with 7 million Mirror vibrates full length of the scale irregularly + shows spots of light – as rate of oscillation is not in time with the Mirror time –

Jerry measured insulation resistance between primary + secondary coils + finds its more than 11 megohms probably 50 as his instrument can't go above 11 –

We now put shunt from
black lines of diagram
page 82 with ——— Megohm
+ Remove ground
wire which was on in
other Experiments -

Cannot repeat any
of the Experiments
only get high rates
through 1 Megohm
Something must
have changed
we now Take off shunt

+ Make reg test phono
stopped & started 2"
phonoplex —

Phonoph stopped quiet as before.

Cant get anything with
the shunt of 1 megohm —

We now reverse the primary
of No 2 audion as Jerry in
testing for modulation is not
certain he put it back
the same way as we got
the big low rate vibrations
got the slow vib again
Tuck ground off still

get the Vibrations, grounded 8/6
makes no Change -
Jarred Every iron box still
Vibrates -

It seems that the Current from
the Secondary of 2nd audion
or rather the Voltage returns
on shunt to Secondary of
No 1 audion which amplifies
it passes it to No 2 secondary
& ~~that~~ the 8 or 10 Vibrations
are the resonant times of
oscillation - While
we get Current in the
Meter, I think we only
get Voltage in shunt

Our Mirror always
stands N + S

We put the Paul in shunt
without any resistance
the needle never stirred
Yet if put in at Mirror it
vibrates 3/8 — looks like
Wattless. Voltage was transferred
across shunt + this
through. 2nd Audion was
twisted into Circuit.
We now increase the Megohms
to 12 Million ohms —
~~We do~~ Edison hears low steamboat
Whistle — Started phonograph
it dont amplify more than
1 inch — hence shunt work

amplification, when 12 Megohm
leakage 12 megohm
dont effect mirror only
little vibration Zero + 3/4"
at time —

We not put in 10 Million
Steamboat whistle
louder ~~[illegible]~~ mirror
not much not affected.
8 million
very days its broken up
a little now at mirror.
vibration very rapid ~~about 3"~~
~~[illegible]~~ off the scale —
6 million —
Note getting lower —
needle wild —
~~[illegible]~~ 4 million
Note now a flutter 6 to 8 sec

4 30 am We know a considerable more than we did & we will now go home

Wednesday pm

Test of App — Open steady — Closed — 90% of time Zero — now & then 1 1/4 once went 2 1/2 good practical Zero for reading 1250 ohm phonopler at 2" gives from 2 3/4 to 4" 2 3/4 lowest reading

We now try high volt battery substituting storage cells for the Leclanche we have been using —

We put Storage Bat - 52 - Cells on
No 1 Audion

Zero after 1 min so quick as good
as Lelande - 1 8" jump + then steady
phonoplex 2 to 4" no return to Zero
practical - average 3 3/4 -

Now we change Lelande on #2
Audion ~~and~~ substitute storage
batteries

at first Zero poor - in 2 minutes
Zero about same on whole
Audion as with Lelande.
Think a little worse
amplification 2 to 4 -
never comes to Zero

Think Storage battery
giving same Voltage
will be OK in place

of helande but each individual battery showed set on a petticoat insulator —
Only 18 to 19 Mil. amp through the 3 lamps at present

We now will add battery to get through regular amount which is 30 Milamp or 10 Milamp per Lamp — 3 Lamps being in Multiple on Each circuit

Now 69 Cells on Each Circuit or 82 Volts — 30 Milamp for the 3 bulbs —

After on 1 min Zero is good now & then goes to 1" - but good Zero

phonoplex started,
5" swing don't fall below
the Extra battery improves
amplification,

Evidently with the number
of cells we have now - The
Storage Battery is OK -

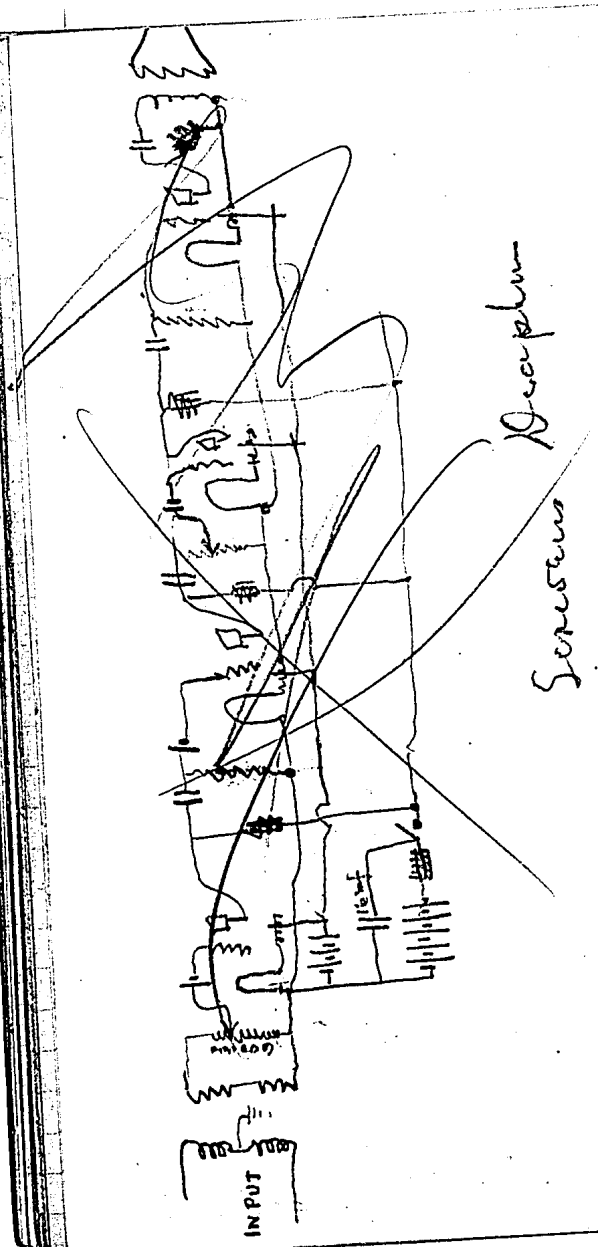
Side Experiment, as additional
Cells improved the amplification
we now add more to see
how far we can go & get
a steady Zero -

Now 138 Volts 30 milliamp -
114 Cells 2000 ohms resistance in
series No 1 Audion -
No 2 Audion same cells & Res

Zero perfect,
phonoplex working 1" swing
The toning down resistance is too
much - The resistance is too
much as it loses amplification

We now remove resistance
in batteries - This gives
138 Volts across Electron
gap - on each Audion

Zero 25% 50% within $1\frac{1}{2}$" &
25% 2" swing - occasional
6" not often -
Swing after starting
Phonoplex $8\frac{1}{2}$"
This is practical but



an account of the poor Zero ~~the~~ of the Current or acquired from the sea was 1/2 this strength, The flickering Zero would make it uncertain

Could we get a Zero with 1" max throw + 80% Zero Could read acquired 1/3rd this strength with certainty

Our big Coils - Each
Secondary Coil 918 ohms
Primary Each 4.03 ohms
as connected Primary 24 ohm Secondary 5500 ohm
Nerium #2 section Output
Coil - 11.015 ohms Each

All lamps Multiple - 1 Cathode -
All the grids tied together Multiple
In fact the only one Condition not
like each amplifying unit -

We now have received an input & an output Coils from American Transformer Co -

The resistance of ~~the~~ Primary output Transformer which has ~~17~~ Coils is 1875 ohms per coil total 22500 ohms

~~Coils for primary~~

Secondary 12 Coils
~~Resistance same~~

Even if all the Coils of primary were in Multiple the Res would be 156 - ohms —

This Coil seems to be wrongly Calculated — or primary 6 Coils 24 ohms
or Else our 4.05 ohm Coil was here is Rotten —

Test =

Same Conditions as named
Phonoplex 2" away
Storage batteries, 138 Volts
Each condition — Battery
grounded on #1 condition —

Phonoplex in 1" throw
Stopped — perfect Zero —

Tried only 1 bulb — got no swing

Now 7000 ohms in primary
15000 secondary
13 milli amperes through to
grid —
Steady Zero OK —
Phonoplex going 2" throw

We now change to
7000 primary & 1/2000 secondary
gives about $2\frac{1}{4}$ Hrow
We must open coil ends to
get it handy for various
combinations - as coil is NG
now in its present condition -

Res of primary 155 ohm
secondary 153 -

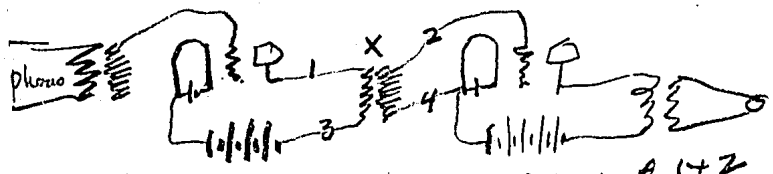
Zero poor. Keeps about 2" + low
with an occasional throw of
4 to 6"
amplifier to 8"

We now double the

Res of primary leaving
Secondary the same
Zero 50% with 1/2" 50% 2"
a jump now & then to 3"
Throw about 8" —

The Nerum Coil is the best
& there is no gain in
this Coil — it is far more
costly & Complicated —

While new Coil is in
we try a special Experiment

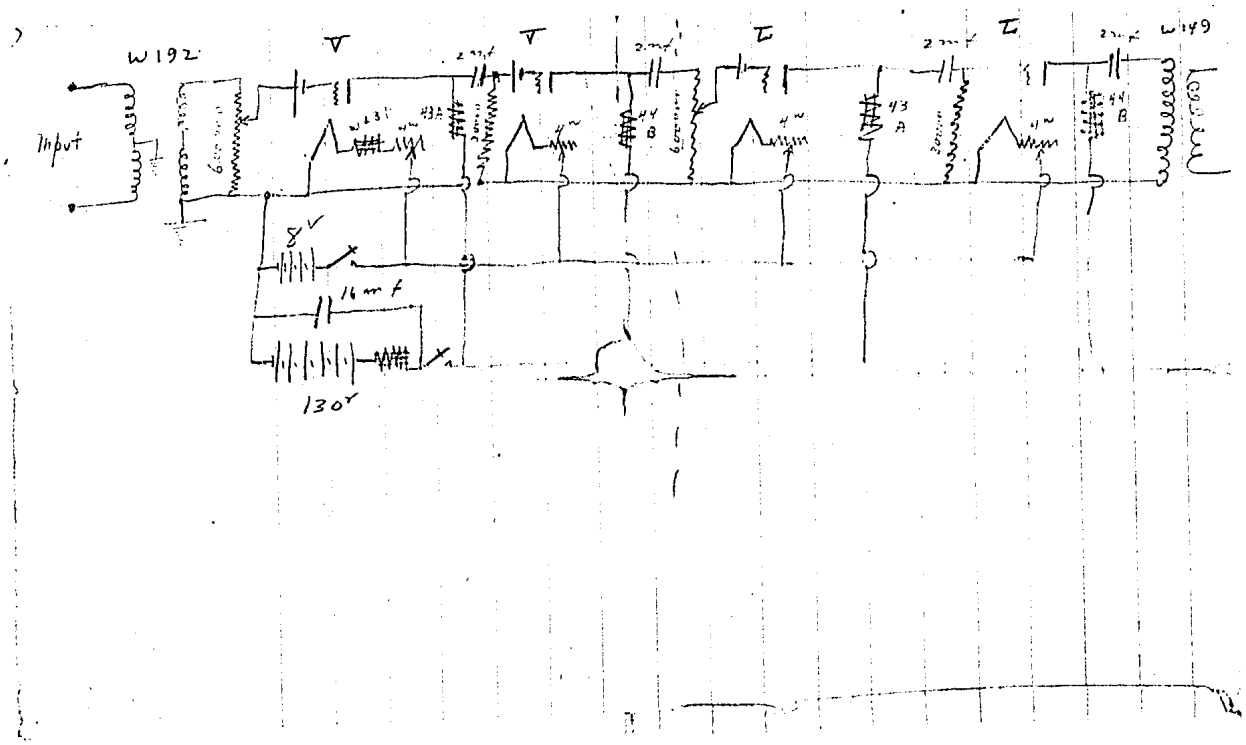


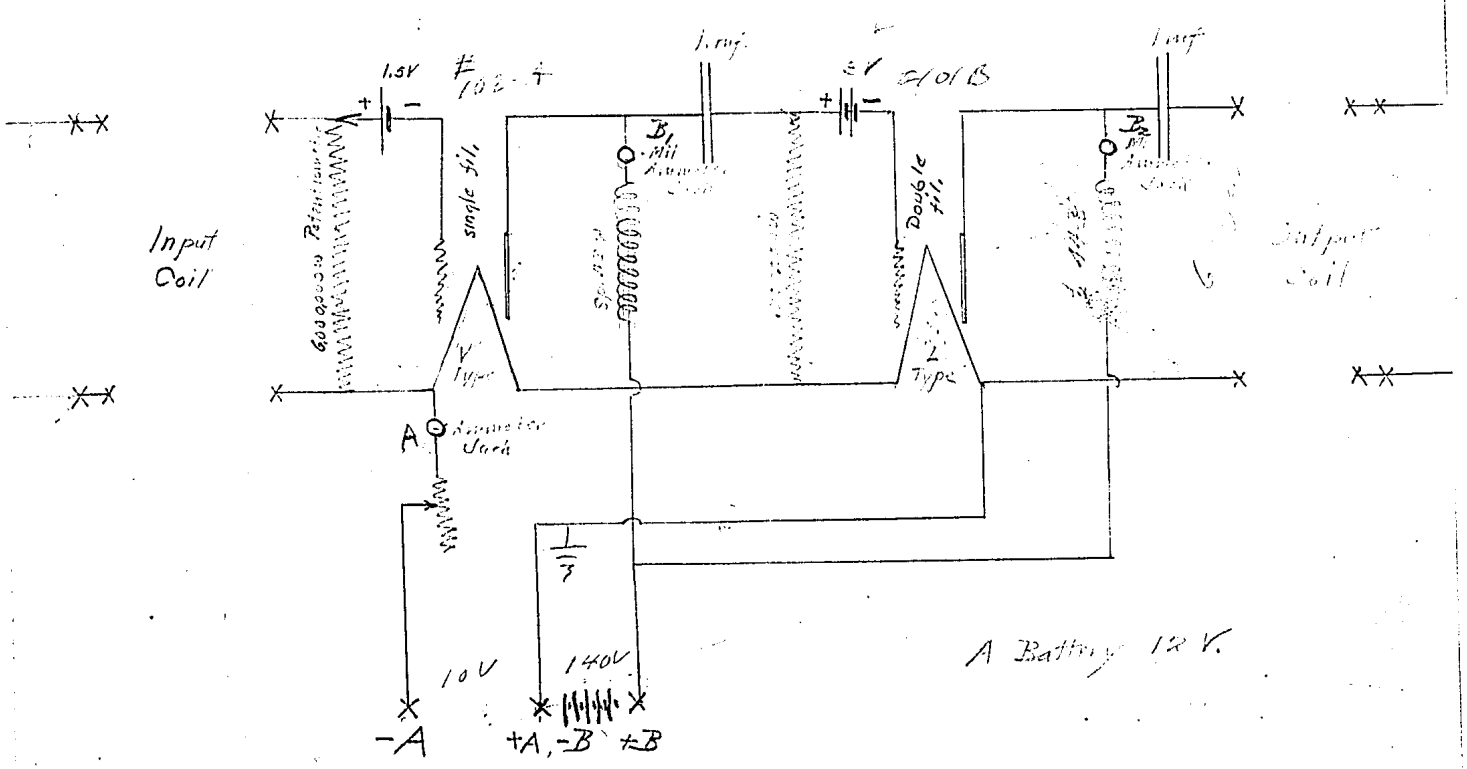
We Remove Induction Coil & put 1+2
together + 3+4 —

Result —

Perfect Zero
amplification 1/4" to 1/2 =
probably if phonoplex was
set at 1 1/2 it would show
something better —
When put an inductance
across (the secondary of receiver) & set phonoplex at
1" got 15" throw —
Showing W Elec multiplex
are play not so good as
our separate system —
We now remove the
inductance ~~system~~ across
line —
It gives 8" throw —

[ITEMS(S) FOUND IN BOOK]



[ITEMS(S) FOUND IN BOOK]

Special Amplifier